

REMARKS

This is intended as a full and complete response to the Office Action dated March 19, 2003, having a shortened statutory period for response set to expire on June 19, 2003. Claims 1, 3-8, and 10-40 are pending in the application and stand rejected. Applicants have cancelled claims 1, 3-7, 24-30, and 40 without prejudice. The cancellation of these claims is not an admission of non-patentability. Applicants have simply cancelled the claims to place the application in condition for allowance or alternatively, to reduce issues for appeal. Applicants also propose new claims 41-50 to more clearly recite aspects of the invention. Please reconsider the claims pending in the application for reasons discussed below.

Claims 1, 3, 5, 6, 7, 24-25 and 27-30 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over EP 0849 779 A2 (*Konecni et al.*) in view of U.S. Patent No. 6,395,150 (*Van Cleemput et al.*). Claims 1, 3, 5, 6, 7, 24-25 and 27-30 also stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,534,445 (*Tran et al.*) in view of U.S. Patent No. 6,395,150 (*Van Cleemput et al.*).

Applicants have cancelled claims 1, 3, 5, 6, 7, 24-25 and 27-30 without prejudice, obviating the rejections. The cancellation of these claims is not an admission of non-patentability. Applicants have cancelled the claims with the intent to place the application in condition for allowance and preserve the right to pursue the cancelled subject matter in a continuation application. Withdrawal of the rejection is respectfully requested.

Claims 4, 8, 10-23, 26 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over EP 0849 779 A2 (*Konecni et al.*) in view of U.S. Patent No. 6,395,150 (*Van Cleemput et al.*) and further in view of U.S. Patent No. 5,935,874 (*Kennard*). Claims 4, 8, 10-23, 26 also stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,534,445 (*Tran et al.*) in view of U.S. Patent No. 6,395,150 (*Van Cleemput et al.*) and further in view of U.S. Patent No. 5,935,874 (*Kennard*). The Examiner states that both *Konecni et al.* and *Tran et al.* teach exposing a substrate surface to a gas mixture of argon, helium and hydrogen. The Examiner admits that the references do not teach, show, or suggest the specific percent by

volume of the gases within the gas mixture. The Examiner, however, asserts that *Van Cleemput et al.* "discloses that etch/dep ratio can be controlled by varying the flow rate of the process gas." The Examiner also asserts that *Van Cleemput et al.* is evidence that the flow rate of the process gases is a result effective variable. The Examiner, therefore, asserts that it would have been obvious to vary the argon flow rates of *Konecni et al.* and *Tran et al.* in view of *Van Cleemput et al.* because "*Van Cleemput et al.* teaches that etch rates are typically increased by increasing the flow rate of argon."

Further, the Examiner states that the prior art (*Konecni et al./ Van Cleemput et al./ Tran et al.*) does not disclose the step of increasing helium. However, the Examiner states that *Kennard* discloses a method for plasma etching a trench comprising the step of "adding/increasing a flow volume of helium" to a plasma etching gas mixture; and therefore, it would have been obvious to modify the combination of *Konecni et al./Van Cleemput et al.* and the combination of *Tran et al./Van Cleemput et al.* by increasing the helium content/flow rate to the gas mixture as per *Kennard* because "*Kennard* teaches that it is believed that the addition of a relatively high flow volume of helium improves the directionality of the etch by increasing the ion energy, thereby increasing the vertical etch rate into the trench." The Examiner further asserts that it would have been obvious to adjust *Konecni et al./Van Cleemput et al.* and *Tran et al./Van Cleemput et al.* helium flow rate by optimizing the same by conducting routine experimentation for the purpose of obtaining the best etch rate.

Applicants respectfully traverse this rejection. *Konecni et al.* and *Tran et al.* do not teach, show, or suggest the specific percent by volume of the gases within the gas mixture, as correctly stated by the Examiner. *Van Cleemput et al.* is specific to an etch/dep process using a gas mixture of silane, oxygen, and argon (not a gas mixture of argon, helium and hydrogen as recited in the allowed claims). (See *Van Cleemput et al.* at col. 1, line 27.) *Van Cleemput et al.* teaches "increasing the flow rate of argon" to "increase etch", as correctly stated by the Examiner. (See *Van Cleemput et al.* at col. 2, lines 10-12.) A combination of the references, therefore, would suggest if anything to increase the flow rate of argon to increase etch using a gas mixture that includes silane, and oxygen. The combination would not motivate or suggest increasing the helium content of the plasma consisting of argon, helium and hydrogen, during etching, as

recited in the base claims. Argon and helium are not interchangeable atoms. The teaching to increase one does not motivate increasing the other. Insofar as it is known to increase the helium of an argon, helium and hydrogen gas mixture, it is only from the Applicant's own disclosure. Obviousness is determined at the time of the invention, not by what is later learned in the art or by what is gleaned from the Applicant's own disclosure. Accordingly, withdrawal of the rejection and allowance of the claims is respectfully requested.

Regarding *Kennard*, the reference discloses adding "a relatively high flow rate" of helium to "a carbonless, oxygen/fluorine-based chemistry". (emphasis added) (See, *Kennard* at col. 3, lines 54-61.) *Kennard* does not teach, show, or suggest increasing the helium content to increase etching of the patterned substrate surface, as recited in the base claims. The Examiner has mistakenly taken *Kennard*'s teaching of "adding" to be a teaching of "increasing". "Adding" and "increasing" are different concepts that are patentably distinct. Therefore, a combination of the references does not motivate or suggest increasing the helium content of a gas mixture consisting of argon, helium and hydrogen to increase etch, as recited in the base claims.

Moreover, *Kennard* is specific to a plasma of fluorocarbon-based chemistry and SF₆/O₂, and does not relate to a gas mixture consisting of helium, hydrogen, and argon as required by the base claims. *Kennard* discloses that "without the use of the high flow of helium... the SF₆/O₂ chemistry has been shown to produce commercially unacceptable etch results." (See, *Kennard* at col. 4, lines 31-34.) *Kennard* also discloses that "particulate contamination is substantially improved compared to techniques that employ the fluorocarbon-based chemistry or the SF₆/O₂ (without the high flow of helium)." (See, *Kennard* at col. 3, line 62 through col. 4, line 3.) *Kennard* goes on to say that the "addition of the high flow of helium substantially increases the ion energy of the plasma since the ionization energy of the helium itself is typically much higher than the energy of either the SF₆ or the O₂." (See, *Kennard* at col. 4, lines 4-12.) *Kennard*'s teaching, therefore, is specific to a plasma of SF₆/O₂ and would not have motivated one with ordinary skill in the art working on a gas mixture consisting of argon, helium and hydrogen, as recited in the claimed invention. Accordingly, withdrawal of the rejection and allowance of the claims is respectfully requested.

Claims 31-40 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over EP 0849 779 A2 (*Konecni et al.*) in view of U.S. Patent No. 5,935,874 (*Kennard*) and further in view of U.S. Patent No. 6,395,150 (*Van Cleemput et al.*). The Applicants' arguments above are equally applicable to this rejection. Accordingly, withdrawal of the rejection and allowance of the claims is respectfully requested.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest the method or apparatus of the present invention. Having addressed all issues set out in the office action, Applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

The prior art made of record is noted. However, it is believed that the secondary references are no more pertinent to the Applicants' disclosure than the primary references cited in the office action. Therefore, it is believed that a detailed discussion of the secondary references is not deemed necessary for a full and complete response to this office action. Accordingly, allowance of the claims is respectfully requested.

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

13. (Amended) The method of claim [13] 8, wherein the gas mixture is introduced into the processing chamber to establish a pressure from about 1 mTorr to about 200 mTorr.

16. (Amended) The method of claim [15] 14, wherein the substrate surface comprises silicon oxide or silicon nitride.

36. (Amended) A method for processing a substrate in a processing chamber, comprising:

exposing a patterned substrate surface at a pressure between about 5 mTorr and about 20 mTorr to a plasma generated at a power level between about 300 watts and about 450 watts from a gas mixture consisting of less than 75% by volume of argon and a mixture of about 95% by volume of helium and about 5% by volume of hydrogen; and

increasing the helium content of the plasma while decreasing the argon content of the plasma.